

ART. II.—*On the Stromatoporoids of the Buchan District, Victoria.*

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[Read 8th April, 1937; issued separately, 29th December, 1937.]

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**Introduction.**

The Middle Devonian limestones of the Buchan district, Victoria, contain large and varied stromatoporoid faunas which hitherto have been little investigated. Collections were made by the writer in 1933 from five rather widely separated localities within the district, from which no fossils have previously been described: Rocky Camp, Commonwealth Quarries; Citadel Rocks, Murrindal River; near Hicks', Murrindal; Cameron's Quarry, South Buchan; Heath's Quarry. The area has not been geologically mapped in detail, and connecting exposures are lacking, so that little is known of the stratigraphical relations between these five localities. At most of the localities the stromatoporoids are associated with abundant corals. F Chapman (1912) has recorded the occurrence of a few Middle Devonian species from the limestones at Spring Creek, where, however, no stromatoporoids were found, and from localities within the township of Buchan.

### Description of Species.

Family ACTINOSTROMATIDAE Nicholson, 1886, emend.  
Stechow, 1922.

#### **Actinostroma** Nicholson 1886.

1886. *Actinostroma* Nicholson, Mon. Brit. Strom., Gen. Introd., p. 75.

Stromatoporoids in which the coenosteum is composed of radial pillars which traverse a number of horizontal laminae. The laminae may be solid or made up of a "hexactinellid" mesh formed by lateral processes given off in whorls from the radial pillars. Skeletal fibre usually not minutely porous. Astrorhizae may be present or absent.

Horizon.—Cambrian-Devonian. Genotype: *A. clathratum* Nicholson, 1886, Mon. Brit. Strom., Gen. Introd., p. 76; 1886-1889, *Ibid.*, p. 131, pl. i., figs. 8-13; pl. xii., figs. 1-5. Devonian of Europe.

#### ACTINOSTROMA STELLULATUM Nicholson.

1886. *Actinostroma stellulatum* Nicholson, Ann. Mag. Nat. Hist., Ser. 5, xvii., p. 231, pl. vi., figs. 8, 9.

1889. *Actinostroma stellulatum* Nicholson, Mon. Brit. Strom., p. 140, pl. xiv., figs. 1-8; pl. xv.

1930. *Actinostroma stellulatum* Yavorsky, Bull. unit. Geol. and Prosp. Service, U.S.S.R., xlix. (4), p. 81, pl. ii., figs. 6-9.

#### ACTINOSTROMA STELLULATUM var. DISTANS, var. nov.

(Pl. II., figs. 1, 2.)

Coenosteum massive, often reaching a large size, composed of latilaminae up to 15 mm. thick, which mark successive stages in its growth; surface gently undulating, with low astrorhizal mamelons; astrorhizae abundant, with branching horizontal canals; separated by distances of 7-8 mm. from centre to centre. Laminae 4-6 in 1 mm., pillars 4-5 in 1 mm.

Vertical sections show a very regular skeletal mesh, made up of stout, slightly inflected horizontal laminae, reaching a thickness of 0.1 mm., and straight, rather thick pillars, which are seen to pass through 12 or 15 laminae in those parts of the sections that are truly vertical. The number of laminae occupying 1 mm. measured vertically varies from 4 to 6, since within the latilaminae, which mark definite interruptions in the growth of the coenosteum, the laminae are periodically crowded. The radial pillars are somewhat more widely spaced (4-5 in 1 mm.) so that the spaces of the skeletal mesh tend to become elongated tangentially. Vertical sections are also characterized by the vertical canals of the astrorhizal systems; these are about 0.2 mm. in diameter, and are in direct connection with the adjacent interlaminae spaces, being marked off only slightly by the faintly upturned edges of the horizontal laminae.

The most conspicuous features of tangential sections are the branching astrorhizal systems and the compact horizontal laminae. Those parts of the sections passing through the interlaminar spaces show the relatively large, rounded cross-sections, sometimes connected by slender processes, but usually isolated, representing the cut ends of the radial pillars, but on passing through a horizontal lamina the section shows the pillars to be united to form a solid plate, which, however, has minute, regularly arranged perforations separated by distances of 0.1-0.2 mm. In places the pillars are seen to be composed of a number of fibres, an appearance which seems to anticipate the porous structure of the skeletal fibre of *Stromatopora* and allied genera.

This form undoubtedly falls into that group of the species of *Actinostroma* in which the coenosteum is made up of regular, isolated pillars and stout, straight or slightly undulating horizontal laminae, i.e., that group of which *A. stellulatum* Nicholson is the most characteristic member. From this European Middle Devonian species the Victorian form is to be separated only by its somewhat coarser skeletal mesh. The laminae are thicker in var. *distans*, and more solid, the pillars being more completely fused than in most European specimens. An example of this species from the Middle Devonian of Gerolstein, in the Eifel district, Germany (Sedgwick Museum, Cambridge, Reg. Nos. A4651, A4662), shows in tangential section a similar alternation of isolated, composite pillars and perforated (and probably porous) horizontal laminae, an aspect which is not so marked in specimens collected by the writer from Lummaton Quarry and other localities in the Torquay district. From *A. stellulatum* var. *italicum* Gortani it is further distinguished by its more regular skeletal mesh, in which, moreover, the interspaces are not elongated tangentially. The skeletal mesh is also more regular and coarser than that of *A. praecursum* Parks, which that author considers to be a Silurian forerunner of the Middle Devonian species. *A. perspicuum* Poëta, from the Middle Devonian (Gg3) of Bohemia, is a related form in which, however, the mesh is much less heavy, being made up of remote, thin, regularly arranged laminae and pillars. *A. matutinum* Nicholson, of the Chaleur Group of Quebec (of doubtful Niagaran age), is probably similar, but has a thicker skeletal mesh made up of stout isolated pillars and gently undulating laminae. The Victorian form is thus best described as a new variety of *A. stellulatum* Nicholson.

Horizon.—Middle Devonian.

Locality.—Very abundant in the limestones of Heath's Quarry, Buchan.

Holotype.—Coll. Dept. of Geology, Univ. of Melbourne, Reg. No. 1610.

## ACTINOSTROMA CONTORTUM, sp. nov.

(Pl. II., figs. 3-6.)

Coenosteum massive, usually large, composed of irregularly flexed and domed horizontal laminae and straight, but irregularly developed radial pillars; laminae 5-8 in 1 mm., pillars 5-6 in 1 mm.; astrorhizae abundant.

The horizontal laminae as seen in vertical sections are thin, and flexed at more or less regular intervals to form astrorhizal mamelons. They are periodically crowded, so that the number in 1 mm. may vary from 5 to 8. Latilaminae do not occur regularly, but interruptions in the growth of a large coenosteum are not infrequent. The radial pillars are slender and are seen in those parts of the section which are truly vertical to pass through ten or more laminae. Usually, however, owing to the contortion of the laminae, such parts are rare and of small extent, so that the species may even take on the appearance of a *Clathrodictyon*. Five or six radial pillars, with the intervening spaces, occupy 1 mm. The superimposed astrorhizal systems apparently have no vertical canal, and a marked irregularity of the skeletal mesh is observed at the axes of the astrorhizal mamelons.

Tangential sections show the cut ends of the radial pillars, which appear as rounded, apparently isolated cross-sections. It is probable that the radial pillars are composed of a number of fibres, a feature already noted in *A. stellulatum* var. *distans*. The horizontal laminae are compact and are possibly perforated as in *A. stellulatum* var. *distans*. Owing to the great curvature of the laminae in the region of the astrorhizal mamelons, the horizontal astrorhizal canals are inconspicuous, since a very small part of their length lies in any given plane.

This abundant species has little affinity with any described species of *Actinostroma*, and in spite of the poor state of preservation in which it is frequently found, it is readily identifiable. In the abundance of astrorhizal mamelons, and their domination of the skeletal mesh, the species recalls *A. verrucosum* (Goldfuss), but it is separated from that Middle Devonian species by the fine, periodically crowded laminae and the isolated radial pillars, and the generally finer skeletal mesh. The character of the tangential section places it in the group of *A. stellulatum* Nich., from which species it is distinguished by the irregularity of the skeletal mesh and the thinner laminae and pillars. The species is very variable in the amount of the curvature and doming of the horizontal laminae, though the contorted aspect is usually more conspicuous in slightly oblique and naturally weathered surfaces. In addition to the commonly occurring form there may be recognized a finer variety of rarer occurrence, in which the laminae are more evenly spaced and

are less flexed, though they are sometimes crumpled at the points of junction with the radial pillars. The upper surface of the coenosteum is covered with small, pointed astrorhizal mamelons, separated by distances of about 1 cm. from centre to centre (Coll. Dept. of Geology, Univ. of Melbourne, Reg. No. 1604, Rocky Camp).

Horizon.—Middle Devonian.

Localities.—Very abundant in the limestones of Rocky Camp, Commonwealth Quarries, but usually in a bad state of preservation. Also present at Heath's Quarry, and near Hicks', Murrindal.

Holotype.—Coll. Dept. of Geology, Univ. of Melbourne, Reg. No. 1611, Heath's Quarry. Figured specimen of finer variety: Reg. No. 1604, Rocky Camp.

#### ACTINOSTROMA COMPACTUM Ripper.

(Pl. II., figs. 7, 8.)

1933. *Actinostroma compactum* Ripper, Proc. Roy. Soc. Vic. (n.s.), xlv. (2), p. 153, figs. 5A, 5B.

Coenosteum massive, latilaminar, often reaching large size; upper surface smooth, with abundant branching astrorhizae; horizontal laminae thin, curved or gently undulating, not domed to form astrorhizal mamelons: laminae 5-7 in 1 mm., pillars 5 in 1 mm.

Vertical sections show a skeletal mesh which, though much finer, is closely similar to that of *A. clathratum* Nicholson. The horizontal laminae are thin and appear to be somewhat crumpled, thus resembling those of *A. intertextum* Nicholson. The radial pillars are slender, straight, and pass through a considerable number of horizontal laminae, but usually do not traverse a whole latilamina (a distance of about 5 mm.). The laminae are commonly crowded at intervals within the latilaminae, and the base of each successive latilamina may be marked by a zone of irregularly vesicular tissue up to 0.5 mm. broad. The astrorhizal systems are apparently not superimposed, and no axial canals are seen in vertical sections: rounded cross-sections, somewhat larger than the spaces of the normal skeletal mesh, probably mark the positions of the horizontal astrorhizal canals.

Tangential sections show the skeletal mesh typical of *Actinostroma*. The radial pillars are connected by delicate radiating processes, four or five of which arise from each pillar. Where the section crosses an interlaminar space, the pillars are usually isolated, though even here occasional processes may be seen. Astrorhizae are abundant, but rather irregularly distributed, the distance between the centres of adjacent systems varying between 5 and 10 mm. The horizontal canals reach a

length of 2-3 mm., are much branched, and merge gradually into the normal skeletal mesh. Tangential sections of this species come very close to similar sections of *A. intertextum* Nich., but the two species are readily separated by the more regular aspect of the skeletal mesh in vertical sections of *A. compactum*, which has better developed horizontal laminae.

This form is similar in every respect to that described as *A. compactum* from the Lilydale limestone of Yeringian age. The abundant specimens from Heath's Quarry, Buchan, are particularly well preserved, and have yielded further details of skeletal structure, and particularly of the external form of the coenostem. At Lilydale the species is of much rarer occurrence and the specimens are in a state of preservation that does not show the external characters. The new material, however, is still fragmentary, and no weathered out specimens have been seen, so that the base and mode of attachment of the coenostem are still unknown.

Horizon.—Middle Devonian.

Localities.—Very abundant at Heath's Quarry. Also present in the limestone of Rocky Camp, Commonwealth Quarries, Buchan.

Figured specimen.—Coll. Dept. of Geology, Univ. of Melbourne, Reg. No. 1617, Heath's Quarry.

### **Clathrodictyon** Nicholson and Murie, 1878.

CLATHRODICTYON REGULARE (von Rosen).

(Pl. III., figs. 1, 2.)

1867. *Stromatopora regularis* von Rosen, "Ueber die Natur der Stromatoporen," etc., p. 74, pl. ix., figs. 1-4.

1937. *Clathrodictyon regulare* Ripper, Proc. Roy. Soc. Vic., 1. (n.s.), 1, p. 2.

(For further synonymy see Ripper, *Ibid.*, 1. (1), 1937, p. 2.

Two examples from the Buchan district, while being referable to this species, differ in some respects from the more typical form occurring at Lilydale and Loyola. The skeletal mesh is very regular and formed by straight or broadly curved, minutely crumpled horizontal laminae, of which four or five occupy 1 mm., and less regularly disposed radial pillars, of which there are a similar number in 1 mm. In the wider spacing of the horizontal laminae, the broadening of the pillars at their upper ends as a consequence of their origin in the crumpling of the laminae, and the arching of the laminae between the pillars, this form is clearly transitional towards *Cl. striatellum* (d'Orbigny), and closely resembles some specimens of *C. regulare* from the Wenlock Limestone of Dudley in the Nicholson Collection, which, however, have a somewhat finer skeletal

TABLE I.—CHARACTERS OF VICTORIAN SPECIES OF *Actinostroma*, AND OF SPECIES WITH WHICH THEY ARE COMPARED.

Species.	Horizon.	Locality.	Laminae.	Pillars.	Astrorhizae.	Form of Coenostemum.
1. Group of <i>A. intertextum</i> Nich.						
<i>Act. intertextum</i> Nich.	Wenlock Zone of <i>Pentamerus eshoni</i>	Great Britain .. Esthonia ..	mm. 5	mm. 5	{ Abundant .. Not superimposed ..	Laminar Crenular No latellinae Massive Latellinae
<i>A. alium</i> Ripper	Yeringian ..	Lillydale, V. ..	4-5	3-4	Probably absent ..	
2. Group of <i>A. cladratum</i> Nich.						
<i>A. cladratum</i> Nich.	Givetian ..	Europe ..	3-4	3-4	{ Irregular .. Not superimposed ..	Massive Latellinae
<i>A. compactum</i> Ripper	Yeringian ..	Lillydale, V. ..	5-7	5-6	{ Abundant, irregular .. Not superimposed ..	Massive Latellinae
<i>A. verrucosum</i> (Goldf.)	Givetian ..	Europe ..	4	5	{ Abundant .. Superimposed ..	Massive
3. Group of <i>A. stellatum</i> Nich.						
<i>A. stellatum</i> Nich.	Givetian ..	Europe ..	6-8	6-7	{ Abundant .. Superimposed ..	Massive Latellinae
<i>A. stellatum</i> var. <i>distans</i> , var. nov.	M. Devonian ..	Buchan, V. ..	4-6	4-5	{ Abundant, regular .. Superimposed ..	Massive Latellinae
<i>A. stellatum</i> var. <i>dehiscens</i> (Gortani)	M. Devonian ..	Carnic Alps ..	3-4	4-5	{ Abundant .. Superimposed ..	Massive Latellinae
<i>A. concolor</i> , sp. nov.	M. Devonian ..	Buchan ..	5-8	5-6	{ Abundant .. Superimposed ..	Massive Irregular latellinae
<i>A. perspicuum</i> Poeta	M. Devonian ..	Bohemia ..	3	3	{ Few? .. Superimposed ..	Massive
<i>A. madibrana</i> Nich.	Chaleur Gp. ..	Quebec ..	4-6	3-4	{ Rare ..	Massive

mesh. The skeletal mesh of these specimens from Buchan, on the other hand, has not the open appearance characteristic of *C. striatellum*, and the pillars are usually solid, rarely showing the hollow cone near their point of origin which is so marked a feature of *C. striatellum*. The pillars in this Victorian form are, however, sometimes tubular, and then appear in tangential sections as rings, a feature which recalls *C. calamosum* Ripper of the Lilydale limestone. It is clear, therefore, that the species *C. regulare*, *C. striatellum*, and *C. calamosum*, together with *C. clarum* Poëta and *C. convictum* Yavorsky, are merely the most conspicuous members of a group which contains all transients between them.

Horizon.—Middle Devonian.

Localities.—Heath's Quarry; near Hicks', Murrindal, Buchan.

Figured specimen.—Coll. Dept. of Geology, Univ. of Melbourne, Reg. No. 1618, Heath's Quarry.

#### CLATHRODICTYON CONFERTUM Nicholson.

(Pl. III., fig. 3.)

1889. *Clathrodictyon confertum* Nicholson, Mon. Brit. Strom., p. 154, pl. xviii., figs. 13, 14.

1915. *Clathrodictyon confertum* Bochnke, Palaeontographica, 61, p. 170, figs. 15, 16.

Coenosteum massive or laminar; characters of surface unknown; built up of thin crumpled laminae, connected by radial pillars formed largely by their inflection; laminae 6 in 1 mm., pillars 6-7 in 1 mm.

Vertical sections show a very fine, regular skeletal mesh in which the horizontal laminae are the dominant element. They are evenly spaced, and no periodical crowding is seen. No grouping into latilaminae is observable, but the specimens available show only very small fragments of the coenosteum, so that their absence cannot be definitely stated. The laminae are crumpled at regular intervals, forming by downward inflections the somewhat more widely spaced radial pillars.

In tangential section the skeletal mesh is irregularly vesicular, and the cut ends of the radial pillars are not readily distinguishable from the edges of the horizontal laminae. Astrorhizae are apparently not present, though this cannot be definitely asserted, in view of the small extent of the tangential sections.

This species is of rare occurrence in the Devonian limestones of the Buchan area, but it is readily identifiable with examples collected by the writer from Hope's Nose, Torquay, as well as with Nicholson's original specimen (Brit. Mus. Nat. Hist., Reg. No. P5981).

Horizon.—Middle Devonian.

Locality.—Rare in the limestone of Cameron's Quarry, Buchan.

Figured specimen.—Coll. Dept. of Geology, Univ. of Melbourne, Reg. No. 1607.



## CLATHRODICTYON CONVICTUM Yavorsky.

(Pl. III., figs. 4-8.)

1929. *Clathrodiction convictum* Yavorsky, Bull. du Comité Géol. Leningrad, 48 (1), pp. 91, 105, pl. vi., fig. 10; pl. ix., figs. 5-7.

Coenosteum massive, without latilaminae, reaching a large size, built up of thin, undulating, slightly crumpled horizontal laminae and stout radial pillars; laminae 3-5 in 1 mm., pillars 4 in 1 mm.; astrorhizae absent.

The external characters of the coenosteum are not observable in the specimens collected from Buchan, since these are all fragments of large masses. In vertical sections the horizontal laminae are seen to be rather thin and irregularly undulating. They are periodically crowded, there being in those parts of the coenosteum up to 5 in 1 mm., while in other places they are much more remote (2 or 3 in 1 mm.). Definite latilaminae are not present. The laminae are minutely crumpled, and the radial pillars, which may sometimes be incomplete, appear to be formed by their downward inflection, being thus thickened at their upper ends.

Very conspicuous in vertical sections are the thin-walled "Caunopora" tubes, which here probably belong to a form of *Syringopora*. They are abundant, regularly spaced at intervals of 1 mm. or more, reach a diameter of about 0.5 mm., and have thin, funnel-shaped tabulae. Horizontal connecting tubes, 0.2 to 0.3 mm. in diameter, are fairly abundant.

Tangential sections show the cut edges of the thin laminae, in the region of which the rounded cross-sections representing the cut ends of the radial pillars are much enlarged and crowded. Elsewhere the cross-sections of the pillars are small, usually isolated dots, which, however, may occasionally be connected by thin lateral processes. Astrorhizae are apparently absent. The "Caunopora" tubes are seen as abundant round cross-sections, in which the tabulae appear as concentric rings. The section may also occasionally traverse longitudinally the horizontal connecting stolons of the "Caunopora."

In some respects this form shows resemblances to *C. striatellum* (d'Orb.), particularly in the thin, crumpled horizontal laminae and the mode of formation of the radial pillars. The author of the species suggests an analogy with *C. regulare* (von Rosen), but points out the absence of a median line in the laminae. It seems too that the laminae are much more delicate than in *C. regulare*, and the skeletal mesh is rather more irregular. Most Victorian specimens have "Caunopora" tubes resembling the corallites of *Syringopora*, though these reach only half the diameter of those in the Oesel specimens figured by Yavorsky. The skeletal mesh is rather variable, even in different parts of the one coenosteum, and some examples, with more remote

horizontal laminae (3-4 in 1 mm.) and very stout radial pillars, which are sometimes tubular, approach *C. calamosum* Ripper of the Lilydale limestone, in which the radial pillars are still obviously formed by the downward inflection of the laminae, but are more often tubular than conical, as they are in *C. striatellum* (d'Orb.) (Coll. Dept. of Geology, Univ. of Melbourne, Reg. No. 1613). A similar form from the Chalannes limestone of the Ancenis Basin, with pillars which are frequently tubular, has been described and figured by Le Maitre (1934, p. 187, pl. XI., fig. 8), who refers it, however, to *C. striatellum* (d'Orb.).

Horizon.—Middle Devonian.

Locality.—Heath's Quarry, Buchan.

Figured specimens.—Coll. Dept. of Geology, Univ. of Melbourne, Reg. Nos. 1613, 1616 (typical form).

The species also occurs in the Cave Limestone, Goodradigbee River, New South Wales.

CLATHRODICTYON CONVICTUM var. DELICATULA, var. nov.

(Pl. IV., figs. 1, 2.)

Coenosteum massive, of large size, non-lamilaminar; horizontal laminae straight or irregularly curved, 7-10 in 1 mm., radial pillars slender, 6-7 in 1 mm.; astrorhizae absent.

The skeletal mesh of this form as seen in vertical and tangential sections is of the same type as that of *C. convictum*, but the laminae are much thinner, more crowded and not so crumpled as in the typical form of the species. Distinct latilaminae are absent, though the laminae are periodically crowded, there being as many as 10 or 11 in 1 mm. in those parts of the coenosteum, and there are interruptions in the deposition of the laminae at irregular intervals. "Caenopora" tubes are abundant, and similar to those in the typical form, but reach a diameter of only 0.2-0.3 mm., while the connecting stolons are still narrower. Tangential sections present a similar appearance, on a smaller scale, to that of corresponding sections of the typical form. Some much smaller examples from Cameron's Quarry have assumed, possibly under unfavorable conditions, a laminar habit, and the coenosteum is built up of irregular latilaminae in which the direction of growth of the laminae is frequently changed. The "Caenopora" tubes are sometimes thick-walled, and up to 0.6 mm. in diameter, and as they grow always at right angles to the plane of the laminae, their course is correspondingly irregular.

Horizon.—Middle Devonian.

Localities.—Rocky Camp, Commonwealth Quarries; Cameron's Quarry, Buchan.

Holotype.—Coll. Dept. of Geology, Univ. of Melbourne, Reg. No. 1606, Rocky Camp.

## CLATHRODICTYON CLARUM Pořta.

(Pl. IV., figs. 3, 4.)

1894. *Clathrodictyon clarum* Pořta, Syst. Sil. du Centre de la Bohême, viii. (1), p. 152, pl. 18, figs. 7, 8.  
 1910. *Clathrodictyon clarum* Pořta, Sitzungsberichte Königl. Böhm. Gesells. d. Wissenschaften in Prag, No. 12, p. 1, and plate.  
 1933. *Clathrodictyon clarum* Le Maitre, Mém. Soc. Géol. France (n.s.), ix. (1), Mém. 20, p. 16, pl. iv., figs. 1-5.

Coenosteum massive or laminar, latilaminar, built up of periodically crowded, sinuous laminae and straight radial pillars; laminae 4-6 in 1 mm., pillars 4-5 in 1 mm.; astrorhizae probably absent.

Vertical sections show a fairly regular skeletal mesh which is dominated by the thin, well defined, slightly crumpled horizontal laminae. These are crowded at rather irregular intervals, and in those parts of the coenosteum where they are more widely spaced a distinctly vesicular structure may arise from the development of short subsidiary laminae which may traverse obliquely an interlaminar space, or, failing to reach the lamina next above, form vesicles by joining the lamina from which they originated. The radial pillars are fairly stout, usually complete and strictly at right angles to the laminae which they connect. In parts of the sections they are clearly seen to be formed by the downward inflection of the laminae. Their distribution in the coenosteum appears to be rather irregular, on account of the variable direction of growth of the laminae, which is a characteristic feature of the species. Polished and weathered surfaces thus resemble sometimes those of *Actinostroma contortum*, sp. nov., in which the mode of growth of the coenosteum is precisely similar. "Caenopora" tubes are abundant and regularly distributed through the coenosteum. They are usually of the thick-walled, probably tabulate type, the "*Syringopora*" type having been observed in only one specimen, and reach a diameter of 0.3-0.5 mm. They are separated by an average distance of 1 mm.

Tangential sections show the cut ends of the radial pillars as rounded cross-sections, which are sometimes connected by sinuous processes. These may, in reality, be the cut edges of the subsidiary incomplete laminae. The true laminae appear as very dense areas in the sections, but this is probably an effect of imperfect preservation. Astrorhizae have not been observed in tangential sections.

The specimens of this form are usually recrystallised, so that the banded aspect of the coenosteum, arising from the periodical crowding of the laminae, is intensified by zones in which all structure is lost, and which thus appear to be very dense. Similarly in tangential sections the laminae sometimes appear

to be compact and structureless. The "Caunopora" tubes have likewise been affected, so that their walls are excessively thickened, and the presence of tabulae is shown by mere traces. The radial pillars in tangential section appear to be structureless and solid, while Poëta (1910) in his description of additional features of this species notes the presence of hollow pillars, appearing as circular cross-sections in tangential sections.

This species belongs to the group containing those forms of *Clathrodictyon* which have a regular skeletal mesh, including such species as *C. regulare* (von Rosen), *C. striatellum* (d'Orb.), *C. neglectum* Poëta and *C. convictum* Yavorsky. From *C. striatellum* it is readily distinguished by the mode of growth of the coenosteum, the greater crowding of the horizontal laminae and the less obviously conical form of the radial pillars. *C. calamosum* Ripper has stout pillars, formed by the downward inflection of the laminae, but these are usually tubular, as shown in tangential sections, and the skeletal mesh is coarser and less regular. *C. convictum* Yavorsky of the Upper Oesel group of Kattri-pank, Oesel, and present also in the Buchan limestones, is probably the most closely allied species, but the mode of growth of the coenosteum is much more regular, and the pillars and laminae, which are more usually crumpled, are more slender than in *C. clarum*. Finally, in *C. linnarssoni* Nicholson of the Wenlock limestone of Wisby, Gotland, the laminae are more crowded and regularly spaced, and in the general aspect of vertical sections the species marks a passage from the group of which *C. vesiculosum* Nich. and Murie is typical.

Horizon.—Middle Devonian.

Localities.—Rocky Camp, Commonwealth Quarries: near Hicks', Murriudal, Buchan.

Figured specimen: Coll. Dept. of Geology, Univ. of Melbourne, Reg. No. 1605, Rocky Camp.

Family STROMATOPORIDAE Nicholson, 1886.

**Stromatopora** Goldfuss, 1826, emend. Nicholson, 1886.

STROMATOPORA aff. FOVEOLATA (Girty).

(Pl. IV., figs. 5, 6.)

1895 *Syringostroma foveolatum* Girty, Rep. State Mus. New York, xlviii. (2), p. 295, pl. vi., figs. 8, 9.

1937. *Stromatopora foveolata* Ripper, Proc. Roy. Soc. Vic. (n.s.), xlix. (2), p. 178.

A specimen from the Buchan district shows the same type of internal structure as the form described from Lilydale, but the skeletal mesh is considerably coarser, so that it should probably be regarded as a distinct variety. The coenosteum is massive and composed of straight latilaminae. The radial pillars are stout,

TABLE 2.—CHARACTERS OF VICTORIAN SPECIES OF *Clathrodictyon*, AND OF SPECIES WITH WHICH THEY ARE COMPARED.

Species.	Horizon.	Locality.	Laminae.	Pillars.	Astrotrichae.	Form of Coenosteum.
Group of <i>Cl. resistibosum</i> Nich. and Mur.						
<i>Cl. confertum</i> Nich.	M. Devonian	Buchan, V. ... Torquay, Devon	8	mm.	Small, abundant	Massive or laminar
<i>Cl. linnaeusii</i> Nich.	Wenlock	Gotland	6-8	5-6	Small, superimposed	Laminar
Group of <i>Cl. striatellum</i> (d'Orb.).						
<i>Cl. striatellum</i> (d'Orb.)	Wenlock	Europe	5 thin, 4-5	4 conical crumpled 3-4 tubular	Absent	Laminar or hemispherical
<i>Cl. calamosum</i> Ripper	Yeringian	Lilydale, V.	3-5 thin, somewhat crumpled	4 sometimes tubular	Absent	Massive, non-laminar
<i>Cl. convexum</i> Yavorsky	U. Oesel	Oesel	7-10	6-7	Absent	Massive, non-laminar
<i>Cl. convexum</i> var. <i>deltatula</i> , var. nov.	M. Devonian	Buchan, V.	less	6-7	Absent	Massive, non-laminar
<i>Cl. regulare</i> (v. Rosen)	Wenlock M. Devonian	Europe France Buchan, V.	6 crumpled arched	4 solid	Absent	Laminar Emericising or massive
<i>Cl. regulare</i> var. <i>calindrifera</i> Ripper.	Yeringian	Lilydale, V.	5-6	3-4	Abundant, imposed	Massive
<i>Cl. clarum</i> Poeta	Fl. M. Devonian	Bohemia Buchan, V.	4-6 straight	4-5 sometimes tubular	Absent?	Massive or laminar, non-laminar
Group of <i>Cl. chapmani</i> Ripper.						
<i>Cl. chapmani</i> Ripper	Yeringian	Lilydale, V.	2-3	Irregular	Abundant, imposed	Massive
<i>Cl. aff. chapmani</i> Ripper	Yeringian	Loyola, V.	6	5	Rare	Massive or laminar

0.1–0.2 mm. thick, and three or four occupy the space of 1 mm. The horizontal laminae are of varying thickness, sometimes being reduced to mere “tabulae”, though their average thickness is 0.2–0.3 mm. They are usually arranged in small groups, two or three of which make up a latilamina. The astrorhizae are well developed, superimposed, and are of the same kind as those of the typical form. The horizontal astrorhizal canals, 0.2–0.3 mm. broad, as well as the vertical axial canal, are crossed by tabulae, which always remain at right angles to the course of the canal. The upturned edges of the laminae bounding the horizontal astrorhizal canals, which are abruptly directed upwards as they approach the centre of the system, give a characteristic aspect to vertical sections of this species. The tangential section shows a mesh more completely reticulate than that of the typical form: the radial pillars are not distinctly recognisable, and the laminae are less compact. The example from Buchan thus appears to combine the features of *S. foveolata* and *S. concentrica* Goldf., and may be regarded, from the point of view of the degree of fusion of the horizontal and vertical skeletal elements, as a transient between these two forms.

Horizon.—Middle Devonian.

Locality.—Rocky Camp, Commonwealth Quarries, Buchan.

Figured specimen.—Coll. Dept. of Geology, Univ. of Melbourne, Reg. No. 1609.

STROMATOPORA CONCENTRICA Goldfuss.

(Pl. IV., figs. 7, 8; Pl. IV., figs. 1, 2.)

1826. *Stromatopora concentrica* Goldfuss, Petrefacta Germaniae, p. 22, pl. viii., figs. 5A-C.
1886. *Stromatopora concentrica* Nicholson, Mon. Brit. Strom., Gen. Introd., p. 2, pl. iii., fig. 5; pl. xi., figs. 15-18.
1891. *Stromatopora concentrica* Nicholson, Mon. Brit. Strom., p. 164, pl. xx., fig. 10; pl. xxi., figs. 1-3; pl. xxiv., figs. 9, 10.
1910. *Stromatopora concentrica* Vinassa de Regny, Boll. R. Com. Geol. d'Ital., xli., p. 46, pl. i., fig. 6.
1912. *Stromatopora concentrica* Gortani, Riv. italiana di paleontologia, xviii., p. 123, pl. iv., figs. 6, 7.
1915. *Stromatopora concentrica* Boehnke, Palaontographica, 61, p. 180, text-figs. 30, 31.
1919. *Stromatopora concentrica* Vinassa de Regny, Pal. Italica, xxiv., p. 113, pl. xi. (vi.), figs. 3-5.
1932. *Stromatopora concentrica* Riabinin, Bull. unit. Geol. and Prospecting Service U.S.S.R., li. (58), p. 860, pl. ii., figs. 5, 6.
1934. *Stromatopora concentrica*, Le Maitre, Mém. Soc. Géol. du Nord, xiii., p. 197, pl. xiii., figs. 6, 7.

(For further synonymy see Nicholson, 1891.)

Coenostemum massive, latilaminar, latilaminae 2–5 mm. thick; built up of moderately well defined radial pillars and less definite horizontal laminae; pillars 7 in 2 mm.; astrorhizae fairly abundant.

The specimens on which this description is based are all fragments of larger masses, so that the original form of the coenosteum and the characters of the exterior cannot be observed. The coenosteum is made up of rather irregular latilaminae, and more pronounced interruptions in the growth of larger masses occur at irregular intervals. A vertical section of one of the larger specimens shows a marked discontinuity, in which growth was at a standstill long enough to permit the development of a coenosteum of a *Stromatoporella* of the type of *S. curiosa* (Barg.), which varies in thickness between 5 and 10 mm. The skeletal tissue first deposited after this interruption is irregularly vermiculate and a zone 2 or 3 mm. broad is passed through before the formation of the normal skeletal mesh is resumed. This is composed of straight, parallel, stout, rather short radial pillars 0.2-0.3 mm. thick, which are connected at intervals of 0.5 mm. or less by irregular processes of varying thickness. The thinner processes, which may be more crowded, are probably the structures referred to by Nicholson in his description of *S. concentrica* and allied forms as the "tabulae" of the "zooidal tubes." At intervals of 1-2 mm. a sufficient number of broad processes may be present at one level to form an irregular lamina, which, however, is not so readily recognizable as a distinct structure as are the radial pillars. Many of the pillars are cut off above such a lamina, so that a line of spaces, rather broader than the normal interpillar spaces, is developed. It is probable that these were occupied by horizontal astrorhizal canals. The presence in vertical sections of groups of highly inclined canals which converge to a centre, but which appear to lack an axial canal in the strict sense, suggests that the astrorhizal systems are superimposed.

Tangential sections show a vermiculate skeletal mesh in which the radial pillars, not recognizable as distinct skeletal elements, are connected by lateral processes of equal or slightly smaller breadth. The resulting mesh is open in appearance, as the sinuous rows of pillars, connected by these processes are separated by rather broader interspaces. The conspicuous astrorhizal systems, separated by distances of about 15 mm. from centre to centre, are composed of 8 or 9 radiating, branching canals, which may reach a length of 5 mm. or more. The skeletal tissue in some examples is very well preserved, and is seen to be minutely porous and apparently composed of anastomosing fibres (Coll. Dept. of Geology, Univ. of Melbourne, Reg. No. 1615).

Some other specimens from the Buchan district, particularly one from Rocky Camp (Coll. Dept. of Geology, Univ. of Melbourne, Reg. No. 1608) resemble in some respects those species of *Syringostroma* in which the skeletal mesh has almost attained the degree of reticulation characteristic of *Stromatopora*. They

are probably best regarded as transients between *Stromatopora foveolata* (Girty) and *S. concentrica*, but are included in the latter species since they correspond very well with some specimens placed in that species by Nicholson. The differences do not warrant the isolation of these examples in a distinct species, since the mesh of *S. concentrica* itself varies from specimen to specimen, and the boundaries between such species as the Helderbergian forms of *Syringostroma*, *Stromatopora foveolata* and *S. concentrica* must at best be arbitrary lines drawn across a continuous series of transients.

These specimens are massive in habit and built up of undulating latilaminae about 2 mm. thick. The skeletal mesh is reticulate, but the radial pillars, 0.1-0.2 mm. thick, are recognizable as distinct elements which may pass without interruption through a whole latilamina. Usually, however, they are confined to shorter distances and traverse only one or two of the feebly developed horizontal laminae (sometimes reduced to "tabulae") which are grouped together in the manner typical of *Syringostroma* and *Stromatopora foveolata*. The intervals between the latilaminae are marked in vertical sections by a series of pores, which probably indicate the positions of the astrorhizal canals. Tangential sections show a completely reticulate mesh in which the radial pillars are not recognizable as distinct skeletal elements. In the interlaminar spaces they are united by processes of similar breadth, forming a vermiculate network, and on the plane of a lamina are completely fused to form a structureless plate with occasional small perforations. Astrorhizae are abundant, though rather irregularly placed, and consist of ten or twelve radiating branching canals 2-3 mm. long. They are thus characteristically small and compact, and are usually not superimposed.

Horizon.—Middle Devonian.

Localities.—Citadel Rocks, Murrindal River; near Hicks', Murindal; Rocky Camp, Commonwealth Quarries; Cameron's Quarry; Heath's Quarry.

Figured specimens.—Coll. Dept. of Geology, Univ. of Melbourne, Reg. Nos. 1608 (Rocky Camp), 1615 (Heath's Quarry).

STROMATOPORA CONCENTRICA var. COLLICULATA Nicholson.

(Pl. V., figs. 3, 4.)

1891. *Stromatopora concentrica* var. *colliculata* Nicholson, Mon. Brit. Strom., p. 165, pl. iii., fig. 5.

Coenostemum massive, non-latilaminar, composed of thick, undulating horizontal laminae and straight radial pillars which may traverse a number of laminae; laminae 3-4 in 1 mm., pillars 3 in 1 mm.; astrorhizae rare.



The external characters of the coenosteum are not observable, since all the specimens are fragments, probably of large masses. Vertical sections show a skeletal mesh which combines the features of *Stromatopora* and *Actinostroma*. The horizontal laminae are well defined, evenly spaced, broadly undulating, and reach a thickness of 0.3 mm. They remain distinct from the straight radial pillars, which are rather more slender, and usually traverse a number of interlaminar spaces. The pillars may become broader at their intersections with the laminae, so that a mesh with rounded apertures is produced. Occasional rounded apertures, of rather larger size than the normal apertures of the mesh, are probably cross-sections of horizontal astrorhizal canals. Interlaminar septa are absent. True latilaminae are not present, though occasional interruptions in the growth of the coenosteum are marked by narrow zones, about 0.5-1 mm. broad, of irregularly reticulate skeletal fibre in which the mesh is much finer than in the rest of the coenosteum. "Caunopora" tubes have not been observed.

Truly tangential sections of any great extent are difficult to obtain on account of the disposition of the laminae into mamelons. The laminae are solid, with occasional small perforations, and the radial pillars in the interlaminar spaces are usually isolated or connected by narrow lateral processes, forming a coarse, imperfectly "hexactinellid" mesh. Definite astrorhizal canals have not been observed in tangential sections, probably owing to the small areas of such sections that are actually parallel to the planes of the laminae, but irregularities in the arrangement of the radial pillars are probably caused by their presence.

The skeletal mesh of this form corresponds well with that of examples of *S. concentrica* var. *colliculata* in the Nicholson Collection. A specimen from Teignmouth in this collection (Brit. Mus. Nat. Hist., Reg. No. P5874) is identical with the Victorian examples in this respect. Nicholson has not given in the Monograph of British Stromatoporoids a separate figure showing the microscopic structure of the variety, but it must be noted that it is in some respects distinct from that of the typical form. In the extreme distinctness of the two skeletal elements this form comes close to some species of *Syringostroma*, but the laminae are rather too thickened to permit its inclusion in that genus, where the laminae are essentially thin and traversed by thickened pillars. Further, the laminae in this form are more evenly spaced and have not the periodical crowding and arrangement in groups which are so characteristic of those species of *Stromatopora* which are more closely related to *Syringostroma*. In these respects *Stromatopora concentrica* var. *colliculata* may show an advance on the typical form, since there the laminae are still arranged in groups and traversed by pillars which often do not extend beyond the boundaries of such a group.

Astrorhizae are apparently not so abundant nor so conspicuous in the Victorian form as in the European specimens described by Nicholson.

Horizon.—Middle Devonian.

Localities.—Heath's Quarry; near Hicks', Murrindal.

Figured specimen.—Coll. Dept. of Geology, Univ. of Melbourne, Reg. No. 1614, Heath's Quarry.

STROMATOPORA HÜPSCHII (Bargatzky).

(Pl. V., figs. 5, 6.)

1881. *Caunopora hüpschii*, Bargatzky "Die Stromatoporen des rheinischen Devons," p. 62.

(For further synonymy see Ripper, Proc. Roy. Soc. Vic., xlix., p. 186, 1937.)

Coenosteum massive, irregularly latilaminar, built up of long, straight radial pillars, which are connected at frequent intervals by slender lateral processes; pillars 6 in 2 mm.; astrorhizae irregularly distributed.

The specimens are fragmentary, so that the external characters of the coenosteum are not observable. Vertical sections show a skeletal mesh which is dominated by the well defined radial pillars. These are straight, stout, their average thickness being 0.2 mm., and reach a considerable length, often traversing a whole latilamina, a distance of 5 mm. or more. The pillars are connected by abundant thin lateral processes ("tabulae" of Nicholson), of which there are usually 6 in 2 mm. They occur at different levels in adjoining interpillar spaces ("zooidal tubes" of Nicholson), so that they do not coalesce at certain levels to form laminae. The astrorhizal canals are not observable in vertical sections. "Caunopora" tubes, when present, are of the *Syringopora* type, with funnel-shaped tabulae. They are of small size, reaching a diameter of 0.3 mm., and are connected by horizontal stolons.

In tangential sections the skeletal mesh is completely reticulate, the pillars being united by processes of equal breadth to form a vermiculate network. Occasional irregularities in this network probably indicate the positions of horizontal astrorhizal canals, but these are not very abundant or highly organized. The skeletal fibre in the better-preserved parts of tangential sections is seen to be coarsely porous.

This form, of which only one undoubted specimen is available, differs somewhat from the typical examples of the species, since the skeletal mesh is rather finer, but is very similar to specimens from the Eifel and Büchel, Germany, in the Nicholson Collection (Brit. Mus. Nat. Hist., Reg. Nos. P5881, P5882). These, however, are in the "Caunopora" state, so that the skeletal mesh

is a little less regular than that of the Victorian specimens. The radial pillars are long, slender and rather more crowded than in the typical form, and are connected occasionally by processes of similar breadth, but more frequently by thin, curved processes, which are much more abundant than in typical examples. There is no concentration of the processes at certain levels to form horizontal laminae. The German examples are rather better preserved than those from Buchan, but there is no doubt of the identity of the two forms.

Horizon.—Middle Devonian.

Localities.—Citadel Rocks, Murrindal River; Rocky Camp, Commonwealth Quarries.

Figured specimens.—Coll. Dept. of Geology, Univ. of Melbourne, Reg. No. 1601.

### **Hermatostroma** Nicholson.

1886. *Hermatostroma* Nicholson, Mon. Brit. Strom., Gen. Introd., p. 105.

Stromatoporoids in which the coenosteum is massive, usually latilaminar, built up of horizontal laminae and continuous radial pillars, which are readily distinguished as separate skeletal elements within the skeletal mesh; skeletal fibre porous or tabulated; astrorhizae may be present.

Genotype.—*H. schlüteri* Nicholson, Mon. Brit. Strom., p. 105, pl. III., figs. 1, 2; pl. XXVIII., figs. 12, 13; wood-cuts, figs. 1, 16, 29, 30, 31, 32, 1886-1892. Middle Devonian of Hebborn, Paffrath district, Germany.

#### HERMATOSTROMA EPISCOPALE Nicholson.

(Pl. V., figs. 7, 8.)

1892. *Hermatostroma episcopale* Nicholson, Mon. Brit. Strom., p. 219, pl. xxviii., figs. 4-11.

1934. *Hermatostroma episcopale* Le Maitre, Mem. Soc. Géol. du Nord, xii., p. 198, pl. xv., figs. 5, 6; pl. xvi., figs. 1, 2.

Coenosteum massive, latilaminar, built up of thick, undulating horizontal laminae and stout radial pillars which may traverse several interlaminar spaces; laminae 2-4 in 1 mm., pillars 2-3 in 1 mm.; astrorhizae present, probably not superimposed.

The surface characters of this form are not readily observable, since the large specimen from Heath's Quarry, on which this description is based, is incomplete. Broken surfaces show the laminae to be undulating, forming broad, low mamelons on which the astrorhizal systems, consisting of numerous horizontal canals 1 cm. or more in length, are situated. The radial pillars are very conspicuous on the broken surfaces, giving the laminae a dotted appearance.

TABLE 3.—CHARACTERS OF VICTORIAN SPECIES OF *Stromatopora*, AND OF SPECIES WITH WHICH THEY ARE COMPARED.

Species.	Horizon.	Locality.	Laminae in 2 mm.	Pillars in 2 mm.	Astrofizae.	Form of Coenosteum.
1. Group of <i>Str. concentrica</i>						
<i>Str. typica</i> v. Rosen	Yeringian	Loyola, V. } Europe }	Irregular	8-12	{ Abundant Branched Abundant Superimposed	{ Massive Lafilammar Massive
<i>Str. foreaduta</i> (Stirty)	Wenlock	Lilydale, V. } Buchan, V. }	8 Thick	8-10 Thick	{	{
	Yeringian	N. America		Discontinuous	{	{
	Devonian	Buchan, V. } Europe }	Irregular	7	{	{
<i>Str. concentrica</i> Goldf.	L. Helderbergian	Buchan, V. } Europe }	Indefinite	6	{	{
	M. Devonian	Buchan, V. } Europe }	6-8 Thick	6	{	{
<i>Str. concentrica</i> var. <i>calliculata</i> Nich.	M. Devonian	Europe }	Undulating		{	{
2. Group of <i>Str. hupschii</i>						
<i>Str. hupschii</i> (Bargatzky).	M. Devonian	Buchan, V. } Europe }	6	6	Rare, indefinite	Massive, irregularly lafilammar
	M. Devonian	Europe }	Processes not coalescing to form definite laminae			
<i>Str. aff. hupschii</i> (Barg.)	Yeringian	Lilydale, V. } Europe }	Indefinite (lateral processes only)	3-4	Absent	Massive
<i>Str. buchabensis</i> (Barg.)	Yeringian	Lilydale, V. } Loyola, V. }	Indefinite (lateral processes only)	5-5	Small Branching, superimposed	Massive
	M. Devonian	Europe }	6	6	Absent	Composed of cylinders
<i>Str. buchabensis</i> var. <i>digitata</i> Nich.	Yeringian	Lilydale, V. } Europe }	Indefinite	6	Absent	
<i>Str. lilydalensis</i> , sp. nov.	Yeringian	Lilydale, V. }	6	6	Absent	

In vertical section the coenosteum is seen to be composed of well defined horizontal laminae, reaching a thickness of 0.2-0.5 mm. and straight radial pillars of a similar thickness. These are sometimes confined to a single interlaminae space, but usually they traverse several laminae with their intervening spaces. The laminae may be periodically crowded, there being in some places as many as four or five in 1 mm., while in others they may be separated by nearly 1 mm., so that vertical sections have a banded appearance. In the better preserved parts of the specimen the laminae are seen to be composed of two parts, so that they have a median clear line similar to that sometimes seen in *Clathrodictyon regulare* (von Rosen), as well as in some species of *Stromatoporella*. The skeletal fibre is finely vesicular. In those parts of the coenosteum where the laminae are crowded, the interlaminae spaces are occupied by irregularly curved partitions ("interlaminae septa" of Nicholson), which form a coarsely vesicular mesh of a similar type, though on a larger scale, to that found within the better preserved laminae.

Tangential sections show the cut ends of the radial pillars as rounded, isolated cross-sections, in which the vesicular nature of the skeletal fibre is easily recognizable. The laminae are compact, with occasional perforations. The astrorhizae, owing to their large size and rather irregular distribution, are not conspicuous in tangential section.

In its external form this specimen is similar to *Hermatostroma schlüteri* Nich. of the Middle Devonian of the Paffrath district, Germany. It is latilaminar, and splits easily along the latilaminar, producing broadly undulating surfaces on which the ends of the radial pillars appear as conspicuous dots. It differs from this species, however, in the possession of large astrorhizae, and shows further in vertical section abundant "interlaminae septa," which give to such sections a characteristic vesicular aspect. Vertical sections of *H. schlüteri*, on the other hand, show a more open skeletal mesh, without vesicular tissue, though occasional "interlaminae septa" may be present. The skeletal fibre of the Victorian specimen appears in the best preserved parts of vertical sections to be minutely vesicular, and no sign of the extensive canal system characteristic of *H. schlüteri* can be observed. Nicholson notes in describing *H. episcopale*, in which the skeletal fibre is porous but without canals, that the solid appearance of the fibre in *H. schlüteri* may be due to imperfect preservation. An examination of the type specimen of *H. schlüteri* (Brit. Mus. Nat. Hist., Reg. No. P5527) suggests that the canals also are largely the result of an unusual mode of preservation in which the axial regions of the pillars have been infiltrated with dark-coloured material, and some sections of *H. episcopale* (B.M.N.H., Reg. No. P5691) show the beginnings of a similar process, though here the minutely

vesicular structure of the skeletal fibre is still obvious. Some traces of this structure, however, are discernible in the less altered parts of vertical sections of *H. schlüteri*.

Horizon.—Middle Devonian.

Locality.—Heath's Quarry.

Figured specimen.—Coll. Dept. of Geology, Univ. of Melbourne, Reg. No. 1612.

HERMATOSTROMA EPISCOPALE var. BUCHANENSIS, var. nov.

(Pl. V., figs. 9, 10.)

A variant of this species, occurring in the Middle Devonian limestones at Murrindal, near Buchan, appears to be sufficiently distinct for separation as a variety. The skeletal mesh is of the same type as that of *H. episcopale*, but is much more irregular, and usually rather coarser. The coenosteum is massive, with indefinite latilaminae, built up of thick, undulating, widely spaced laminae which may be separated by as much as 1 mm. The laminae have an average thickness of 0.3 mm. and are traversed by radial pillars of a similar breadth. The pillars are quite often restricted to one interlaminae space, and a characteristic appearance is given to vertical sections by the tapering ends of the pillars, which project into an interlaminae space after crossing a number of laminae. "Interlaminae septa" are very abundant, particularly in those parts of the coenosteum where the laminae are very remote, and the skeletal mesh shows, in the interlaminae spaces, a distinct resemblance, on a small scale, to that of *Labechia*.

Tangential sections show no features of special interest. The cut ends of the radial pillars appear as large rounded cross-sections which are isolated in the interlaminae spaces and coalesce on the planes of the laminae, forming dense plates with few perforations. Astrorhizae have not been observed in the tangential sections so far examined. These, however, are necessarily of small extent on account of the irregular mode of growth of the form. It is possible, therefore, that remote and poorly organized systems would not affect the skeletal mesh as seen in such sections.

Horizon.—Middle Devonian.

Locality.—Near Hicks', Murrindal.

Figured specimens.—Coll. Dept. of Geology, Univ. of Melbourne, Reg. Nos. 1602 (vertical section), 1603 (tangential section).

## Notes on the Faunas.

The distribution and relative abundance of the stromatoporoid species occurring in the Buchan limestones are indicated below:—

Species.	Localities.				
	Rocky Camp.	Near Hicks'.	Citadel Rocks.	Cameron's Quarry.	Heath's Quarry.
<i>Actinostroma compactum</i> Ripper .. ..	c	..	..	..	cc
<i>A. stellulatum</i> var. <i>distans</i> , var. nov. .. ..	..	..	..	..	cc
<i>A. contortum</i> , sp. nov. .. ..	c	x	..	..	x
<i>Clathrodictyon regulare</i> (v. Rosen) .. ..	..	x	..	..	r
<i>C. convictum</i> Yavorsky .. ..	..	..	..	..	x
<i>C. convictum</i> var. <i>delicatula</i> , var. nov. .. ..	r	..	..	..	..
<i>C. clarum</i> Pošta .. ..	c	x	..	x	..
<i>Stromatopora</i> aff. <i>foveolata</i> (Girty) .. ..	r	..	..	..	..
<i>S. concentrica</i> Goldfuss .. ..	c	c	x	cc	fc
<i>S. var. colliculata</i> Nicholson .. ..	x	fc	..	..	fc
<i>S. hüpschii</i> (Bargatzky) .. ..	?	..	x	..	..
<i>Hermatostroma episcopale</i> Nicholson .. ..	..	..	..	..	r
<i>Hermatostroma episcopale</i> var. <i>buchanensis</i> , var. nov. .. ..	..	fc	..	..	..

In the above Table—

- x* indicates the occurrence of a species.  
*r* indicates that it is rare.  
*fc* indicates that it is fairly common.  
*c* indicates that it is abundant.  
*cc* indicates that it is very abundant.

Stromatoporoids are abundant in the limestones at Buchan, but the faunas, while being rich in individuals, usually contain a relatively small number of species, of which one or two may be particularly abundant and lend character to the assemblage.

CITADEL ROCKS, MURRINDAL RIVER: The stromatoporoids are here associated with *Syringopora speleana* Eth. fil., of Middle Devonian age. Only two species, *Stromatopora concentrica* Goldfuss and *S. hüpschii* (Barg.), both occurring also in the Middle Devonian limestones of the Torquay district and in the Givetian (Middle Devonian) of the Eifel, Germany, have so far been found.

NEAR HICKS', MURRINDAL: The stromatoporoids are associated with "*Cyathophyllum heterophyllum*" of Middle Devonian age. The fauna consists of six forms, four of which have already been described from other regions:

<i>Clathrodictyon clarum</i> Pošta	Ff2 (Lower Devonian)	Bohemia.
<i>C. regulare</i> (von Rosen)	Wenlock	Great Britain. Gotland.
<i>Stromatopora concentrica</i> Goldfuss	Givetian	Devon, Eifel.
<i>Stromatopora concentrica</i> var. <i>colliculata</i> Nicholson	Givetian	Devon, Eifel.
and one is a variety of <i>Hermatostroma episcopale</i> Nicholson	Givetian	Devon.

The remaining species, *Actinostroma contortum*, sp. nov., is most closely allied to *A. stellulatum* Nich. of the Givetian of Devon and the Eifel.

CAMERON'S QUARRY: The fauna here, associated with corals of Middle Devonian type, is a small one, containing only four species, of which three are well-known European forms. *Clathrodictyon confertum* Nicholson is fairly abundant in the Middle Devonian limestones of Torquay, South Devon, and *Stromatopora concentrica* Goldfuss, one of the most frequently occurring forms (five in a collection of nine specimens), is a characteristic species in the Givetian of Great Britain and Germany. *Clathrodictyon clarum* Pořta, which is rather rare in this fauna, is abundant in the Lower Devonian of Bohemia. The fourth form, which is fairly abundant, is a variety of *Clathrodictyon convictum* Yavorsky, occurring in the Upper Oesel beds (Upper Silurian) of Kattri-pank, Oesel. As far as can be judged from the few species present, therefore, this fauna has Middle Devonian affinities.

ROCKY CAMP, COMMONWEALTH QUARRIES: The fauna consists of eight species, of which five also occur in other faunas:

<i>Clathrodictyon clarum</i> Pořta	Ff2 (Lower Devonian)	Bohemia.
<i>Stromatopora foveolata</i> (Girty)	Helderbergian	New York.
<i>S. concentrica</i> Goldfuss	Givetian	Devon, Eifel.
<i>S. concentrica</i> var. <i>colliculata</i> Nich.	Givetian	Devon, Eifel.
<i>S. hüpschii</i> (Barg.)	Givetian	Devon, Eifel, Paffrath.

Of the remaining species, *Actinostroma compactum* Ripper occurs also in the Yeringian limestone of Lilydale, and is of the type of *A. clathratum* Nich., a characteristic Middle Devonian species in Great Britain and Europe. *A. contortum*, sp. nov., has affinities with *A. stellulatum* Nich. of the Middle Devonian of Great Britain and Europe. Of rare occurrence is *Clathrodictyon convictum* var. *delicatula*, var. nov., a variety of a form present in the Upper Oesel beds of Oesel. The presence of this Upper Silurian species of *Clathrodictyon*, *A. compactum* and *Stromatopora* aff. *foveolata*, an intermediate transient in the *Syringostroma-Stromatopora* series, suggests that the limestone at this locality may possibly be on a lower horizon than that of the other localities whose stromatoporoid faunas have been examined, though two of the three most abundant species, *A. contortum* and *S. concentrica*, are of Middle Devonian type. The third, *C. clarum*, occurs in the Lower Devonian of Bohemia, and is also found, in less abundance and associated with stromatoporoid faunas of more definite Middle Devonian affinities, at other localities within the Buchan district.

HEATH'S QUARRY: Stromatoporoids are very abundant, but the fauna is relatively poor in species, owing to the great abundance of certain forms which dominate the assemblage.



The following species occur also in other assemblages (excluding those from Victoria):

<i>Clathrodictyon regulare</i> (von Rosen)	{ Wenlock	Great Britain. Gotland.
<i>C. convictum</i> Yavorsky	{ Coblenzian-Eifelian	France.
<i>Stromatopora concentrica</i> Goldfuss	Upper Oesel	Oesel.
<i>Stromatopora concentrica</i> var. <i>colliculata</i> Nicholson	Givetian	Devon, Eifel.
<i>Hermatostroma episcopale</i> Nicholson	Givetian	Devon.

as well as a variety of *A. stellulatum* Nich., which is characteristic of the Givetian of Great Britain and Germany. *A. contortum*, sp. nov. and *A. compactum* Ripper are so far known only from Victoria: the first is fairly abundant at some other localities in the Buchan district, notably at Rocky Camp, where it makes up over 40 per cent. of the assemblage. *A. compactum*, first described (Ripper, 1937) from the Yeringian limestone of Lilydale, is more abundant here than at the type locality, making up 38 per cent. of the assemblage, and is present also, though less abundantly, at Rocky Camp. The whole assemblage probably indicates a Middle Devonian age, despite the presence of forms usually occurring in the Wenlock and the Upper Oesel. These, however, are rare, making up little over 5 per cent. of the fauna. The most abundant forms are *Act. stellulatum* var. *distan.*, *A. compactum* and *Str. concentrica* and its variety *colliculata*, which are either themselves typically Middle Devonian, or belong to groups commonly occurring at that horizon.

### Summary.

This paper deals with the stromatoporoid faunas of the Middle Devonian limestones of the Buchan district, and the descriptions of species are based on collections made from five localities within the district. Fourteen species and varieties are described, of which the following are new:

*Actinostroma stellulatum* var. *distan.*, var. nov.

*A. contortum*, sp. nov.

*Clathrodictyon convictum* var. *delicatula*, var. nov.

*Hermatostroma episcopale* var. *buchanensis*, var. nov.

The stromatoporoid assemblages have, in the main, definite Middle Devonian affinities, though typical Wenlock species, e.g., *Clathrodictyon regulare* (von Rosen), persist and make up a small proportion of the fauna. The limestone at Rocky Camp, Buchan, may possibly be on a lower horizon than that of the other localities, since it contains a higher proportion of Upper Silurian and Lower Devonian forms, though even here the typically Middle Devonian species predominate and give character to the assemblage.

## References.

- BARGATZKY, A., 1881. Die Stromatoporen des rheinischen Devons.
- BOEHNKE, K., 1915. Die Stromatoporen der nordischen Silurgeschiebe in Norddeutschland und in Holland. *Palaontographica*, lxi., pp. 147-190.
- CHAPMAN, F., 1912. Reports on Fossils: Middle Devonian of the Buchan District. *Rec. Geol. Surv. Vic.*, iii. (2), pp. 218-222.
- GORTANI, M., 1912. Stromatoporoidi devoniani del Monte Coglians (Alpi Carniche). *Riv. Ital. di Paleont.*, xviii., pp. 117-128.
- LE MAITRE, D., 1934. Études sur la Faune des Calcaires devoniens du Bassin d'Aucenis. Calcaire de Chaudefonds et Calcaire de Chalennes (Maine-et-Loire). *Mém. Soc. Géol. du Nord*, xii.
- NICHOLSON, H. A., 1886-1892. A Monograph of the British Stromatopoids. *Pal. Soc.*, London.
- , 1886. On some new or imperfectly known Species of Stromatopoids: Part I. *Ann. Mag. Nat. Hist.*, Ser. 5, xvii., pp. 225-239.
- , and MURIE, J., 1878. On the Minute Structure of *Stromatopora* and its Allies. *Journ. Linn. Soc. (Zoology)*, xiv., pp. 187-246.
- POČTA, P., 1894, in *Syst. Silurien du Centre de la Bohême*, viii. (1) pp. 133-164.
- POČTA, P., 1910. Ueber eine Stromatoporoide aus böhmischen Devon. *Sitzungsber. Königl. Böhm. Ges. d. Wissensch. in Prag*, No. 12.
- RIABININ, V., 1932. Devonian Stromatoporoidea of Timan. *Bull. unit. Geol. and Prospecting Serv. U.S.S.R.*, li. (58), pp. 855-870.
- RIPPER, E. A., 1933. The Stromatopoids of the Lilydale Limestone. *Proc. Roy. Soc. Vic. (n.s.)*, xlv. (2), pp. 152-164.
- , 1937. Ditto. Part II. *Ibid.*, xlix. (2), p. 178.
- , 1937. On some Stromatopoids from Griffith's Quarry, Loyola, Victoria. *Ibid.*, l. (1), p. 1.
- VON ROSEN, F., 1867. Ueber die Natur der Stromatoporen, etc.
- STECHOW, E., 1922. Zur Systematik der Hydrozoen, Stromatoporen, Anthozoen und Ctenophoren. *Archiv f. Naturgeschichte*, abt. A, lxxxviii. (3), pp. 141-155.
- VINASSA DE REGNY, P. E., 1910. Rilevamento Geologico della Tavoleta "Paluzza." *Boll. R. Com. geol. d'Ital.*, xli., pp. 29-66.
- , 1919. Coralli mesodevonici della Carnia. *Palaont. Ital.* xxiv., pp. 59-120.
- YAVORSKY, B., 1929. Silurian Stromatopoids. *Bull. Com. Géol. Leningrad*, xlviii. (1), pp. 77-114.
- , 1930. Actinostromidae from the Devonian of the Borders of the Kuznetzk Basin and of the Urals. *Bull. unit. Geol. and Prosp. Serv. U.S.S.R.*, xlix. (4), pp. 73-96.

**Explanation of Plates.**

## Plate II.

- Fig. 1.—*Actinostroma stellulatum* var. *distans*, var. nov. Heath's Quarry, Buchan. Vertical section showing axial canal of an astrorhizal system. Coll. Dept. of Geology, Univ. of Melbourne, Reg. No. 1610.  $\times 8.5$  approx.
- Fig. 2.—Same species and variety. Tangential section of the same specimen.  $\times 8.5$  approx.
- Fig. 3.—*Actinostroma contortum*, sp. nov. Heath's Quarry, Buchan. Vertical section. Coll. Dept. of Geology, Univ. of Melbourne, Reg. No. 1611.  $\times 8.5$  approx.
- Fig. 4.—Same species. Tangential section of the same specimen.  $\times 8.5$  approx.
- Fig. 5.—Same species. A finer variety. Rocky Camp, Buchan. Vertical section. Coll. Dept. of Geology, Univ. of Melbourne, Reg. No. 1604.  $\times 8.5$  approx.
- Fig. 6.—Same species. Tangential section of the same specimen.  $\times 8.5$  approx.
- Fig. 7.—*Actinostroma compactum* Ripper. Heath's Quarry, Buchan. Vertical section. Coll. Dept. of Geology, Univ. of Melbourne, Reg. No. 1617.  $\times 8.5$  approx.
- Fig. 8.—Same species. Tangential section of the same specimen.  $\times 8.5$  approx.

## Plate III.

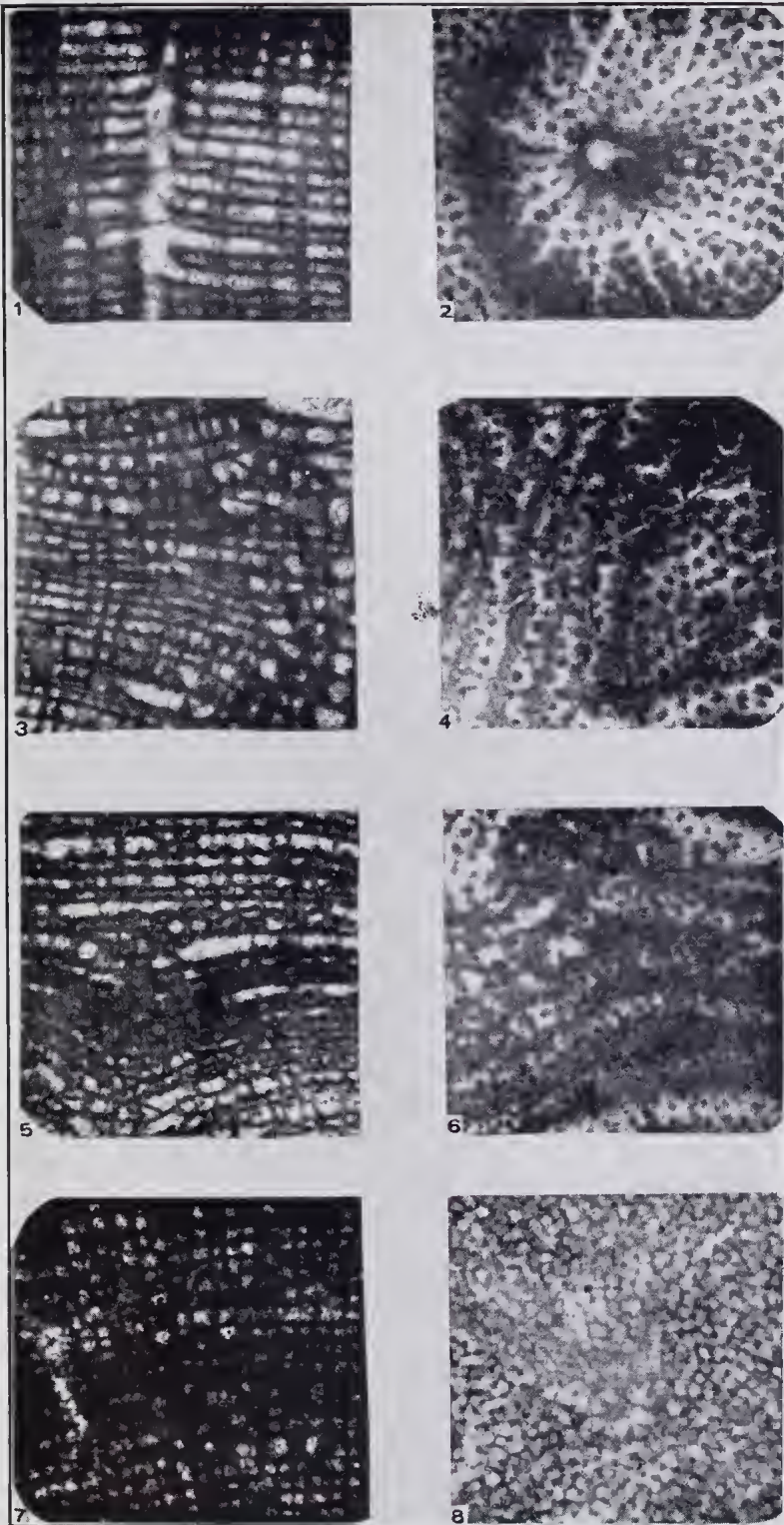
- Fig. 1.—*Clathrodictyon regulare* (von Rosen). Heath's Quarry, Buchan. Vertical section. Coll. Dept. of Geology, Univ. of Melbourne, Reg. No. 1618.  $\times 8.5$  approx.
- Fig. 2.—Same species. Tangential section of the same specimen.  $\times 8.5$  approx.
- Fig. 3.—*C. confertum* Nicholson. Cameron's Quarry, Buchan. Vertical section. Coll. Dept. of Geology, Univ. of Melbourne, Reg. No. 1607.  $\times 8.5$  approx.
- Fig. 4.—*C. convictum* Yavorsky. Heath's Quarry, Buchan. Vertical section. Coll. Dept. of Geology, Univ. of Melbourne, Reg. No. 1616.  $\times 4$  approx.
- Fig. 5.—Same species. Vertical section of the same specimen.  $\times 8.5$  approx.
- Fig. 6.—Same species. Tangential section of the same specimen.  $\times 8.5$  approx.
- Fig. 7.—Same species. Form showing affinities with *C. calamosum* Ripper. Heath's Quarry, Buchan. Vertical section. Coll. Dept. of Geology, Univ. of Melbourne, Reg. No. 1613.  $\times 8.5$  approx.
- Fig. 8.—Same species. Tangential section of the same specimen.  $\times 8.5$  approx.

## Plate IV.

- Fig. 1.—*Clathrodictyon convictum* var. *delicatula*, var. nov. Rocky Camp, Buchan. Vertical section. Coll. Dept. of Geology, Univ. of Melbourne, Reg. No. 1660.  $\times 8.5$  approx.
- Fig. 2.—Same species and variety. Tangential section of the same specimen.  $\times 8.5$  approx.
- Fig. 3.—*C. clarum* Pořta. Rocky Camp, Buchan. Vertical section. Coll. Dept. of Geology, Univ. of Melbourne, Reg. No. 1605.  $\times 8.5$  approx.
- Fig. 4.—Same species. Tangential section of the same specimen.  $\times 8.5$  approx.
- Fig. 5.—*Stromatopora* aff. *foveolata* (Girty). Rocky Camp, Buchan. Vertical section. Coll. Dept. of Geology, Univ. of Melbourne, Reg. No. 1609.  $\times 4$  approx.
- Fig. 6.—Same form. Tangential section of the same specimen.  $\times 4$
- Fig. 7.—*S. concentrica* Goldfuss. Rocky Camp, Buchan. Vertical section. Coll. Dept. of Geology, Univ. of Melbourne, Reg. No. 1608.  $\times 4$  approx.
- Fig. 8.—Same species. Tangential section of the same specimen.  $\times 4$  approx.

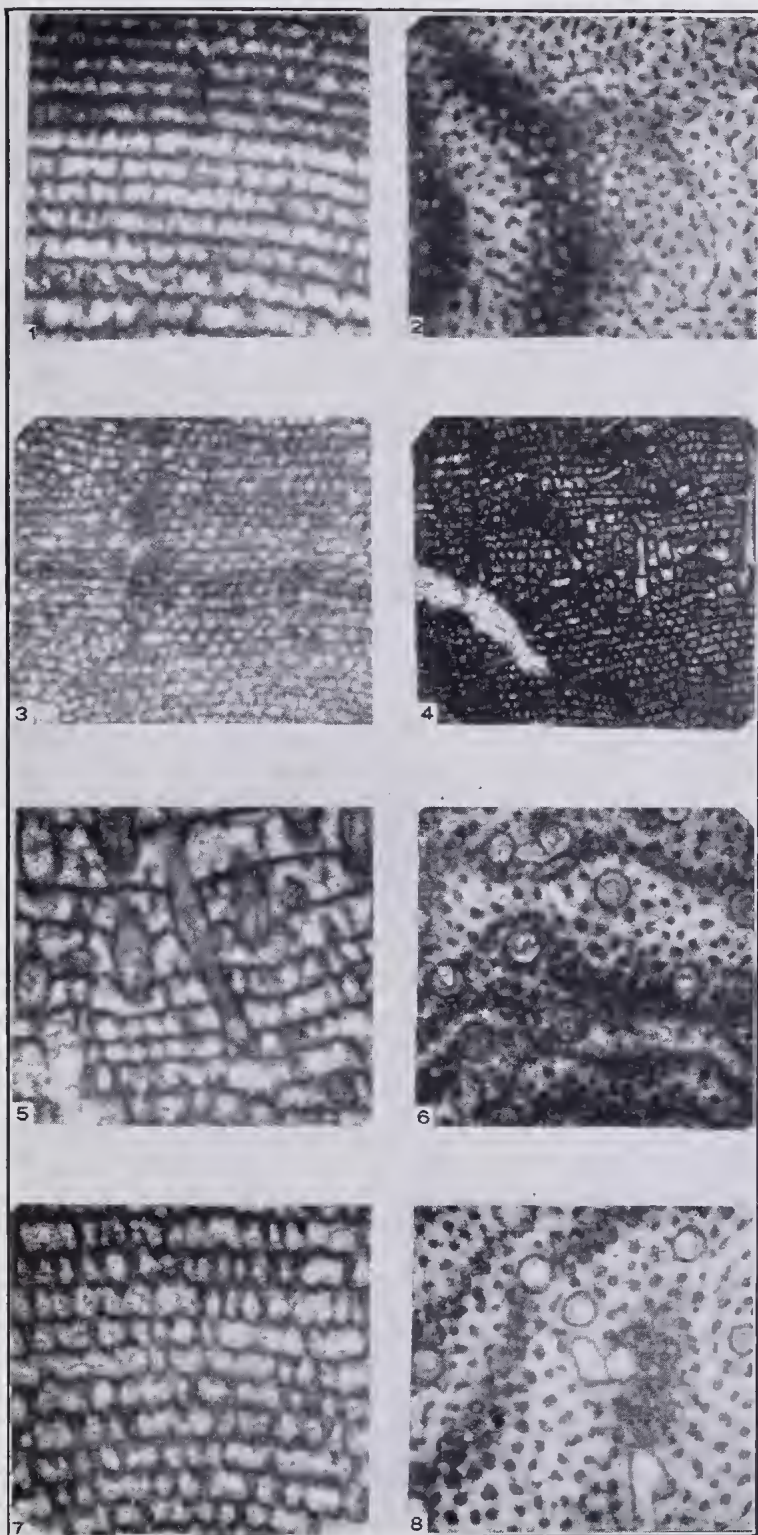
## Plate V.

- Fig. 1.—*Stromatopora concentrica* Goldfuss. Heath's Quarry, Buchan. Vertical section. Coll. Dept. of Geology, Univ. of Melbourne, Reg. No. 1615.  $\times 4$  approx.
- Fig. 2.—Same species. Tangential section of the same specimen.  $\times 4$  approx.
- Fig. 3.—*S. concentrica* var. *colliculata* Nicholson. Heath's Quarry, Buchan. Vertical section. Coll. Dept. of Geology, Univ. of Melbourne, Reg. No. 1614.  $\times 4$  approx.
- Fig. 4.—Same species and variety. Tangential section of the same specimen.  $\times 4$  approx.
- Fig. 5.—*S. hüpschii* (Bargatzky). Citadel Rocks, Murrindal River, Buchan. Vertical section. Coll. Dept. of Geology, Univ. of Melbourne, Reg. No. 1601.  $\times 4$  approx.
- Fig. 6.—Same species. Tangential section of the same specimen.  $\times 4$  approx.
- Fig. 7.—*Hermatostroma episcopale* Nicholson. Heath's Quarry, Buchan. Vertical section. Coll. Dept. of Geology, Univ. of Melbourne, Reg. No. 1612.  $\times 4$  approx.
- Fig. 8.—Same species. Tangential section of the same specimen.  $\times 4$  approx.
- Fig. 9.—*H. episcopale* var. *buchanensis*, var. nov. Near Hicks', Murrindal, Buchan. Vertical section. Coll. Dept. of Geology, Univ. of Melbourne, Reg. No. 1602.  $\times 4$  approx.
- Fig. 10.—Same species and variety. Tangential section of another specimen from the same locality. Coll. Dept. of Geology, Univ. of Melbourne, Reg. No. 1603.  $\times 4$  approx.



Buchan Stromatoporoids.

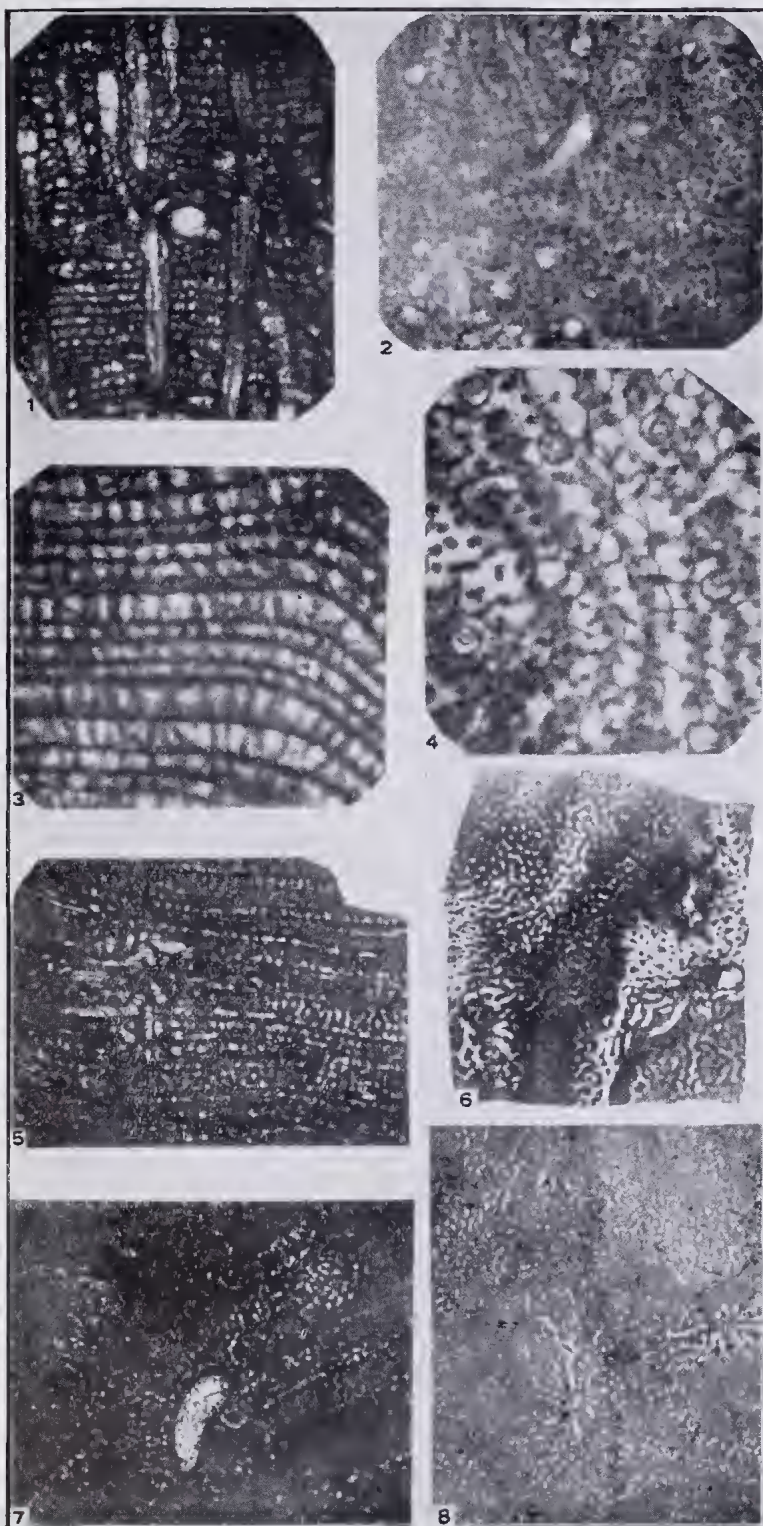
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Buchan Stromatoporoids.

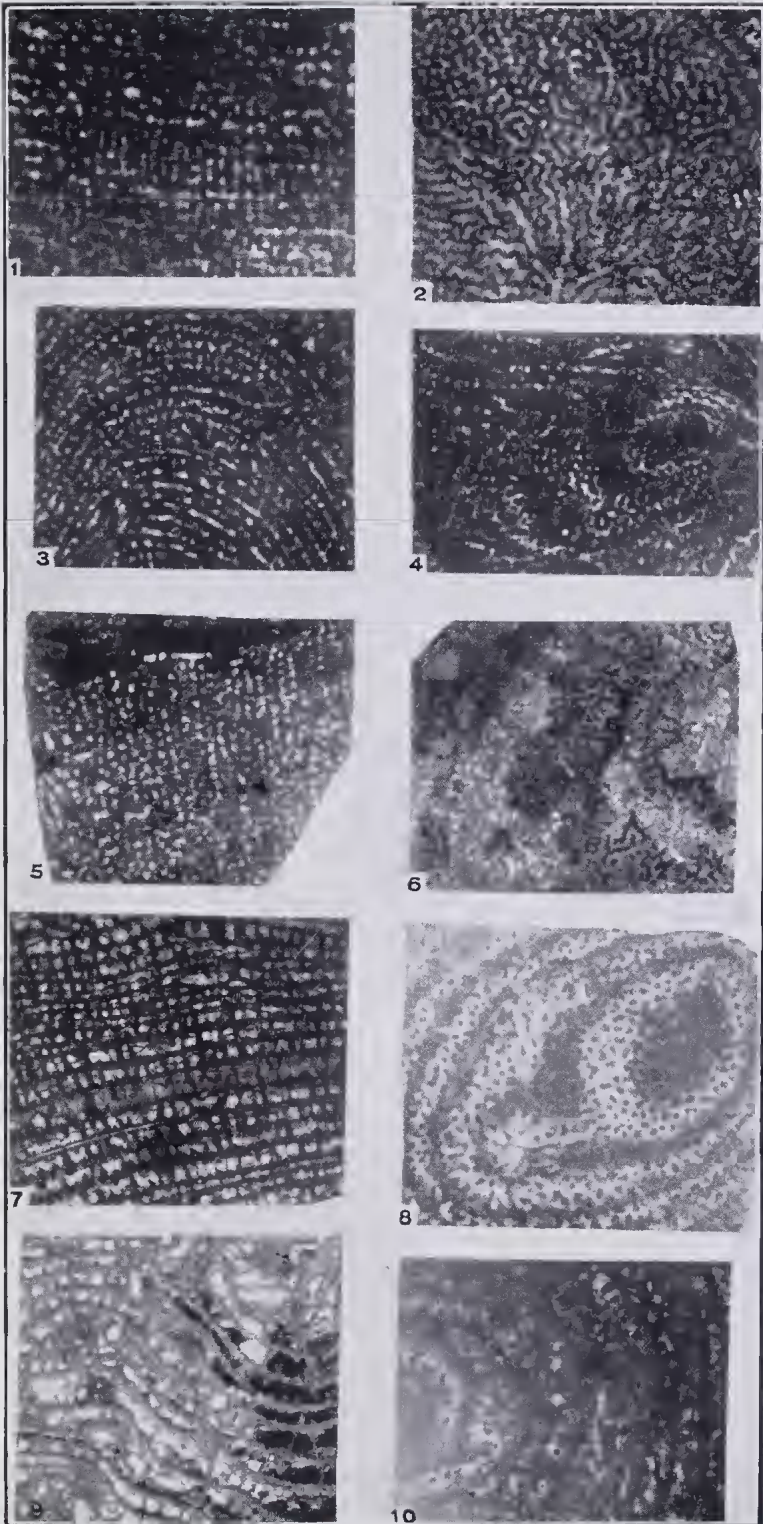
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